CLAIMS

What is claimed is:

1. A method for selectively etching a semiconductor feature openings to controllably achieve a critical dimension accuracy comprising the steps of:

providing a semiconductor wafer comprising a first opening formed extending through a thickness of at least one dielectric insulating layer and having an uppermost inorganic BARC layer;

depositing a photoresist layer over the uppermost BARC layer and patterning the photoresist layer to form an etching pattern for etching a second opening overlying and encompassing the first opening;

carrying out a first plasma assisted etching process to etch through a thickness of the BARC layer comprising a predetermined amount of CO in a plasma etching chemistry to increase an etching resistance of the photoresist layer; and,

carrying out a second plasma assisted etching process to etch through a thickness portion of the at least one dielectric insulating layer to form the second opening.

2. The method of claim 1, wherein the first and second openings comprise one of a damascene and dual damascene structure.

3. The method of claim 1, wherein the inorganic BARC layer is formed of a material selected from the group consisting of silicon oxynitride, silicon oxycarbide, and titanium nitride.

4. The method of claim 1, wherein the photoresist layer is formed of a photoresist comprising one of an I-line novolak photoresist and a DUV photoresist.

5. The method of claim 1, wherein the photoresist layer comprises polymeric monomer groups selected from the group consisting of hydroxystyrenes and acrylates.

6. The method of claim 1, wherein the predetermined amount of CO comprises from about 3 percent to about 20 percent by volume of the plasma etching chemistry.

7. The method of claim 1, wherein the plasma etching chemistry consists essentially of at least one of a hydrofluorocarbon and fluorocarbon, nitrogen, an inert gas, and carbon monoxide.

8. The method of claim 7, wherein the first plasma assisted etching process operating conditions include an operating pressure of between about 30 milliTorr and about 200 milliTorr, an RF power of between about 200 Watts and about 1000 Watts, and a flow rate of CO between about 5 sccm and about 100 sccm.

9. The method of claim 1, wherein patterning the photoresist layer comprises at least one of an ultraviolet treatment process and a post development baking process following development of the photoresist.

10. The method of claim 1, further comprising the step of an ashing process comprising CF_4 and oxygen (O_2) to remove the photoresist layer following the step of carrying out a second plasma assisted etching process.

11. The method of claim 1, wherein the predetermined amount of CO is selectively added to control a tapered sidewall angle defined by an upper portion of the second opening and a bottom portion of the second opening between about 0.2 degrees and about 2 degrees.

12. A method for selectively etching a semiconductor feature openings to with an increased photoresist etching resistance to achieve a predetermined critical dimension comprising the steps of:

providing a semiconductor wafer comprising a first opening formed extending through a thickness of at least one dielectric insulating layer and having an uppermost inorganic BARC layer;

depositing a photoresist layer over the uppermost BARC layer and patterning the photoresist layer to form an etching pattern for etching a second opening overlying and encompassing the first opening;

carrying out a first plasma assisted etching process comprising a plasma etching chemistry having a predetermined amount of CO to etch through a thickness of the BARC layer to increase an photoresist layer etching resistance by inducing polymeric cross-linking reactions in the photoresist layer; and,

carrying out a second plasma assisted etching process to etch through a thickness portion of the at least one dielectric insulating layer to form a second opening comprising a predetermined CD bias.

13. The method of claim 12, wherein the first and second openings comprise one of a damascene and dual damascene structure.

14. The method of claim 12, wherein the inorganic BARC layer is formed of a material selected from the group consisting of silicon oxynitride, silicon oxycarbide, and titanium nitride.

15. The method of claim 12, wherein the photoresist layer is formed of a photoresist selected form the group consisting of novolak resins including at least one photosensitizer, and DUV photoresists comprising at least one photogenerated acid (PAG).

16. The method of claim 12, wherein the photoresist layer is formed of a photoresist comprising functional groups selected from the group consisting of hydroxystyrenes, acrylates, and cyclic olefins.

17. The method of claim 12, wherein the predetermined amount of CO comprises from about 5 percent to about 20 percent by volume of the plasma etching chemistry.

18. The method of claim 1, wherein the plasma etching chemistry consists essentially of at least one of a hydrofluorocarbon and fluorocarbon, nitrogen, an inert gas, and carbon monoxide.

19. The method of claim 1, wherein patterning the photoresist layer comprises at least one of a deep ultraviolet (DUV) treatment process and a post development baking process following development of the photoresist.

20. The method of claim 1, wherein the predetermined amount of CO is selectively added to control a tapered sidewall angle defined by an upper portion of the second opening and a bottom portion of the second opening between about 0.2 degrees and about 2 degrees.